Title: **MONITORING AND REPORTING OF COMMUNICATIONS LINE TRAFFIC INFORMATION**

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CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C. § 119(e) from provisional application no. 60/171,415, filed December 21, 1999. The 60/171,415 provisional application is incorporated by reference herein, in its entirety, for all purposes.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to the field of communications traffic and traffic-sensitive resources including (but not limited to) trunks, lines, radio channels, etc. More particularly, the present invention relates to a method and apparatus for receiving, processing, and sending communications traffic information via a network to a visual display system.

2. Background Information

Telecommunications traffic is transmitted via channels known as lines or trunks. Since the amount of telecommunications traffic varies with time, and because telephone companies strive to make sure that there is sufficient channel capacity when traffic needs are at their highest, allocation of traffic to each trunk is made with the intention that there be plenty of capacity to handle peak demands. Algorithms allocating resources to handle traffic

are merely predictive since there is no perfect *a priori* information on what demand will be for different types of telecommunications traffic flowing between different places.

Presently there are a number of different schemes available to help telecommunications service providers analyze their trunk utilization. Some systems store communications traffic information in a database and present it in table or graph form when requested by a user. These presentations are generic and not customized to specific users. Some systems configure a telephone switch to output communications traffic information in text-only reports. Typically, these systems are configured as databases that store traffic information and then permit a user to retrieve and manipulate that information. One example of such a system is Metrica NPR. Another example is Applied Digital Access' *Traffic Data Collection and Engineering Operations System.* These systems, and similar products, require that communications traffic data be stored in a database and then presented to a user only after the user requests data for a specific time period. AAPA

Current database-oriented products do not provide a metering function for communications system traffic-sensitive resource utilization because they store information in a database and then require a user to request information from the database for a specific time period.

Referring to **Fig. 1**, a conventional telecommunications traffic monitoring data handling database system is illustrated. Text or binary data indicative of trunk traffic is generated by a switch **101** and is provided to a processor **103**. The processor **103** warehouses the data received from the switch **101** in a database **105**. Upon receipt of specific commands

from a user **107**, the processor **103** retrieves select data from the database **105** for interpretation by the user **107**.

Other conventional systems provide for real time displays of the number of traffic-sensitive resources currently in use at the present moment. These real time displays are based on transitory swings in telephony traffic, not necessarily reflective of the true, ongoing resource demand. Conventional real time systems are generally custom-designed systems created by individual communications system operators. Some real time systems produce graphical depictions of traffic information on a single display unit connected to a switching system either directly or via a collection device. In other words, these conventional systems do not make the graphical depictions available across a network.

Current real-time displays of the number of traffic-sensitive resources in use (as may be available directly on a switching system maintenance terminal) don't give a valid estimation of average utilization. That is because, by presenting real time data, they are subject to the bursty nature of communications traffic. False indications of average resource utilization can be obtained depending on whether a higher than average or lower than average traffic intensity is in effect at the time the display is observed. Furthermore, these display methods do not make use of accepted Erlang-B or Poisson formula based methods for estimating the traffic carrying capacity of a resource based on blocking probability and number of switches in the resource.

Systems that report traffic utilization in text-only format are less useful than graphic systems as they require more user interpretation in order to compare values between different

resources than would be required if each resource's utilization were presented in a graphic format.

What is needed is a system that uses data sampled over a standard traffic reporting interval such as one hour, calculates utilization percentage based on resource size, desired blocking probability, and Erlang-B or Poisson formulas, and sends out the resulting utilization information in a form that will generate a graphic display of the estimated percentage utilization of the traffic sensitive resource(s), after each interval.

Furthermore, what is needed is a system that presents data tailored to a user's specific needs, unlike requesting information for a specific time period that will be extracted from the database on demand. What is needed is a meter system that is available upon a full sample of traffic information has been made and displayed in a manner readily usable by the requester.

Also, what is needed is a way for geographically diverse communications operating organizations to monitor resources in multiple locations without requiring human presence at each switching facility and without requiring links dedicated to the task of moving traffic data between each monitoring location and each communications switching facility being monitored.

Also what is needed is a way for technically diverse members (technicians, engineers, planners, operators, customer service personnel, etc.) of a communications operating organization to be able to focus attention first on the elements of the traffic data that are relevant to their respective primary responsibilities within the organization.

Also, what is needed is a way for geographically diverse communications operating organizations to be able to maintain historical maintenance and event tracking information in

a log that is available at any location in the organization, and a way for a separate log of this type to exist for each traffic-sensitive resource.

Also, what is needed is a way for casual or occasional users of the information to be able to understand what each traffic-sensitive resource is used for or what it connects to without having to perform extra steps to look up this information. In other words, a method is needed for automatically showing a description of the traffic sensitive resource along with the resource utilization graphs.

Also, what is needed is a way to estimate the minimum number of switches needed to handle the traffic during the most recent sampling interval given a specified blocking probability, in order to provide maintenance personnel within a communications operating organization the ability to estimate how many switches may be removed from active service within a resource for maintenance purposes.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide near real time receiving, processing and sending of communications traffic information.

It is another object of the present invention to provide communications traffic information in a format that doesn't require a database.

It is yet another object of the present invention to provide traffic metering functionality, wherein a graphical display of utilization percentage of traffic sensitive resources is provided with automatic processing of traffic data and resending of display information when new traffic information is available from a communications system.

It is a further object of the present invention to provide an intermediate term linear forecast of trunk resource utilization based on historic utilization analysis.

It is yet another object of the present invention to provide dynamic alert messaging when trunk utilization exceeds a predefined threshold.

It is another object of the present invention to provide dynamic alert messaging when multiple trunk demand threshold events occur within a fixed time period.

It is yet another object of the present invention to provide at a listing of most utilized trunk groups across multiple switches for current time period and for peak time periods.

It is a further object of the present invention to provide at a listing at a web site of most utilized trunk groups across multiple switches for a current time period and for peak time periods.

It is an additional object of the present invention to provide near real time receiving, processing and sending of communications traffic information regarding a selected subset of trunks at a given switch.

It is still another object of the present invention to provide a capability to display estimated number of switches required and available for each resource.

It is a further object of the present invention to provide a network-oriented system whereby the sending of traffic information is over a network.

It is an additional object of the present invention to provide for a groupware function to promote communication and understanding of events and actions relating to each traffic-sensitive resource in a communications system.

It is another object of the present invention to provide a capability of sending to a multitude of devices, including but not limited to desktop devices and handheld devices.

It is an object of the present invention to provide a graphical display function that is accessible by all levels of employees within a communications operating organization.

It is another object of the present invention to provide an expanded description capability to indicate what type of traffic is carried by each traffic-sensitive resource.

It is yet another object of the present invention to provide a capability to have a database add-on in the event that historical data is desired.

It is still another object of the present invention to provide a capability to accommodate multiple input-data formats of the raw traffic data, to allow functionality with communications systems from multiple vendors.

It is a further object of the present invention to provide a capability to see when input data was not received for a particular time interval.

It is an additional object of the present invention to provide a capability to use encrypted and/or authenticated data transmission between the switching facility and the traffic monitoring server, and between the traffic monitoring server and the graphical display systems at any number of monitoring locations.

It is another object of the present invention to provide a capability to have multiple views of the traffic data, to suit the needs of different types of users of the traffic data. This may include (but is not limited to) a view sorted by capacity, a view sorted by mean holding time, and/or a view sorted by number of resource members required for a given blocking probability and traffic usage level above or below the present number of members available.

The present invention provides meter functionality for communications traffic and traffic sensitive resources. As traffic data from a standard measuring interval such as one hour is made available to the invention from a communications switching system, the invention receives the data, processes it, and creates the output necessary to send the information to a display device for graphical indication of communications resource utilization.

The data received from the voice switching system is processed according to the present invention, which means key data elements are extracted. The extracted data includes at a minimum, but is not limited to, the following pieces of data sampled over a standard time interval (typically one hour):

- Traffic usage per resource
- Seizure attempts per resource
- Number of servers per resource
- Out-of-service (OOS) usage per resource
- OOS servers during the sample

The processing of communications system data is performed as soon as the data is available from the system. The output data representing a graphical display of the processed input data is made available as soon as processing has completed. As part of the graphical display information, numerical values may be included (associated with each resource) that represent performance parameters. These performance parameters include (but are not limited to) the number of out-of-service members, mean holding time, answer-seizure ratio,

number of members required, number of members defined in the resource, and actual traffic usage level.

Some advantages of the present invention include:

- Near-real-time output/meter functionality
- Graphical output format of utilization
- Self refreshing display
- Capability of sending graphic output over a network
- Database not required
- Network distribution of graphical output information
- Estimation of number of servers required for each resource
- Indication of number of servers available for each resource
- Smoothing of data so as not to over react to bursty activity
- Analysis can be tailored to a subset of trunks, i.e., can be tailored to a single user
- Automated notification of reaching of a simple threshold condition or of complex threshold conditions
- Resource requirement projection based on historical utilization
- "Hot spot" identification of trunk groups, e.g., top 20 peak demand groups
- Sortability by capacity and performance parameters to focus attention on traffic-affecting problems by magnitude of the problem
- On-line Log function for each resource which provides communication across time and across geography about maintenance or other events relating to each traffic-sensitive resource, which reduces time wasted by members of an organization

- Encrypted and/or authenticated transmission of traffic data from the switching facility to the traffic monitoring server, and from the traffic monitoring server to the graphical display systems
- Spreadsheet output format capability (e.g., comma-separated values) for exporting data to electronic spreadsheet programs
- Capability to store usage levels over time in order to provide a graphical peak values display
- Capability to store the time intervals for which traffic data has been received, in order to generate a graphic depiction of the times when traffic data was unavailable
- Capability to display the raw traffic data along with the graphical traffic data in order to allow users to compare the two if needed
- Capability to display a history of the traffic information per resource as a chart showing the pattern of resource utilization as well as any performance parameters, including but not limited to overflow or answer/seizure ratio, over time.
- Network-accessible help displays so that users do not have to maintain paper copies of instructions or reference materials at each location where the graphical traffic information is accessed
- Capable of working with communications systems from multiple vendors

BRIEF DESCRIPTION OF THE DRAWING

Additional objects and advantages of the present invention will be apparent in the following detailed description read in conjunction with the accompanying drawing figures.

Fig. 1 illustrates a conventional telecommunications traffic monitoring data handling database system.

Fig. 2 illustrates how a network-based telecommunications traffic monitoring system, according to one embodiment of the present invention (and including an optional database), is integrated with a telecommunications switch.

Fig. 3 illustrates how a network-based telecommunications traffic monitoring system, according to another embodiment of the present invention, is integrated with plural telecommunications switches.

Fig. 4 illustrates how a network-based telecommunications traffic monitoring system, according to yet another embodiment of the present invention, is integrated with plural telecommunications switches.

Fig. 5 illustrates how a network-based telecommunications traffic monitoring system, according to still another embodiment of the present invention, is integrated with plural telecommunications switches.

Fig. 6 illustrates a network-based telecommunications traffic monitoring system, according to a preferred embodiment of the present invention, integrated with plural switches.

Fig. 7 illustrates how a network-based telecommunications traffic monitoring system, according to another embodiment of the present invention, is integrated with plural telecommunications switches.

Fig. 8 illustrates an example of a switch traffic status display page, according to an embodiment of the present invention.

Fig. 9 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein only basic statistics are displayed.

Fig. 10 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein full statistics are displayed.

Fig. 11 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein peak usage data are displayed.

Fig. 12 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein raw traffic data from a switch is displayed.

Fig. 13 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein availability of data from a switch is displayed.

Fig. 14 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to overflow status.

Fig. 15 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to the number of trunks in a trunk group that are out of service.

Fig. 16 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to mean hold time statistics for calls for each trunk group.

Fig. 17 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to the answer/seizure ratio statistics for each trunk group.

Fig. 18 illustrates an example of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted for purposes of analyzing trunk grou

p sizing based on sufficiently of traffic capacity.

DETAILED DESCRIPTION OF THE INVENTION

This description uses the nomenclature "traffic monitoring," which may also be understood by those of skill in the art as "traffic metering." In other words, "monitoring" as referred herein is intended to have the meaning of "metering" as is understood in the art of telecommunications traffic analysis.

This invention accepts traffic and performance data from a communications system such as a voice switching system in a fixed or wireless telephone network, or such as a data switching system. Traffic usage data may be transferred on a scheduled basis from the communications system or it may be automatically requested from the communications system by the invention. This transfer may be done over a serial line or it may be via a network connection using a protocol such as FTP or HTTP.

The traffic data should represent measurements taken over a standard sampling interval such as one hour.

Once the traffic data is transferred, it is stored in a file within the traffic monitoring server. The server then refers to a map-file that contains information about the location within the traffic data file of the following key elements of information:

- start and stop time of the traffic data report
- usage during the interval (inbound, outbound, total, or a combination of these)

- number of servers (e.g., trunks) in service during the sampling interval
- call attempts, answered calls, overflow counts and/or percentages (or a combination of these), or none of these
- out of service resources (e.g., trunks), or out of service usage of the resources

Using a system configuration file, the server determines what map-file should be used to extract the key information elements such as those mentioned above, and what unit conversion factor is necessary to convert the traffic usage measurements in the traffic data file into a common unit such as hundred call seconds per hour. Using the correct map-file and conversion factor, the server extracts the key data, converts it as needed, and stores the resulting data in an array variable.

The server looks at the number of resource members available, and looks into an Erlang-B or Poisson table to extract the amount of usage that can be carried by that number of members given a specified blocking probability. The server computes the ratio of usage to carriable usage for the given blocking probability to create a utilization percentage and stores this percentage in an array.

The server sorts the utilization values in the array and creates graphical information based on the sorted values. The graphical information may include but is not limited to Hypertext Markup Language (HTML), Handheld Device Markup Language (HDML), Wireless Markup Language (WML), and Extensible Markup Language (XML).

The server creates multiple views of the same data that may be accessed as needed by communications operator personnel in order to accomplish their primary tasks within the organization. The server also provides numerical information in its views to describe key

performance factors that may be needed, including but not limited to members required, members available, mean holding time on a resource, answer/seizure ratio on a resource, reported traffic level on the resource, and incoming and outgoing seizures of the resource.

For communications operator personnel who need to extract the same data to an electronic spreadsheet program, the server may create comma-separated-value representations of the data for direct export to a spreadsheet program capable of importing comma-separated data.

These graphical views of data are provided on a near real time basis. Providing graphical representations of estimated resource utilization calculations on a near real time basis for review by the subscriber is very useful because it avoids the problem of not being able to make useful sense of a true real time utilization display due the bursty nature of such data streams. The near real time display is also advantageous over the conventional database formats that do not provide data on a timely basis and that place a substantial search and processing burden on the subscriber seeking to view the data. Providing a display that is based on statistical analysis of an appropriate time sample and that is then promptly provided for viewing fits the meaning (for purposes of this disclosure) of "near real time."

The server may keep a history of when raw traffic data was received from a communications switching system, so that a graphical depiction of data availability can be created. This graphical depiction can be used to obtain a fast indication of how often raw traffic data was unavailable to the server for processing.

The server may also keep a history of the traffic information per resource so that a chart can be created as needed showing the pattern of resource utilization over time. One

optional aspect of the present invention is to use an intermediate term of data (e.g., 21 days) to predict utilization requirements over some next interim period of time (e.g., 6 weeks).

The server is optionally programmed to deliver alerts when certain utilization thresholds are reached. According to one aspect of this functionality, alerts are based upon a simple criterion such as a factor of calls blocked or exceeding any other absolute threshold of interest. It is also an aspect of the present invention that an alert optionally be based on more complex criteria such as achieving a predetermined number of saturation conditions over a predetermined span of hours.

The server may also make the raw traffic data available along with the graphical depiction of the data, in order to allow users to verify the accuracy of the server's calculations if necessary.

The server may also keep a history per resource of traffic levels over time so that peak traffic levels can be obtained and displayed along with the date and time of the peaks.

One embodiment of the present invention provides a list of the most utilized resources such as trunk groups across multiple switches during peak periods as well as current periods. This so called "hot spots" list may be published at a web site or other display locations. The hot spots list is preferably updated dynamically.

The server provides the graphical traffic data information in such a way that display devices on a connected network can access the data. The access may be done using encryption and/or authentication in order to protect the security of the graphical information as it moves from the server to the display system.

Access to the traffic data can be via wired connectivity, wireless connectivity, or a combination of both.

In a preferred embodiment, the communications switching system will send raw traffic data to a computer in the communications operator's network that will store the traffic data in files. A scheduled job on this computer will automatically send the files over a TCP/IP network to a statistics relay unit (a function of the invention being claimed) which will transfer the file using encryption to the traffic monitoring server located at a distant location, either within the communications operator's network, or outside the network. The traffic monitoring server will process the file and generate HTML pages representing the different views that may be desired, and make these files available across a network via an HTTP server.

Referring to **Fig. 2**, integration of a telecommunications switch with a network-based telecommunications traffic monitoring system, according to one embodiment of the present invention, is illustrated. A telecommunications switch **201** provides traffic data, either in the form of binary data or text traffic reports, to a traffic monitoring server **203**. In addition to receiving the traffic data from the switch **201**, the server **203** processes the data into a form suitable for cogent presentation and sends the processed data on for remote display. The processed data is sent by the server **203** to a display unit **207** via a network **205**. A user **209** views the processed traffic data as displayed on the display unit **207**.

Optionally, the traffic monitoring system includes a database **211**. The database **211** is provided in the event that the user **209** wishes to review old records for historical analysis or other purposes.

Referring to **Fig. 3**, integration of plural telecommunications switches with a network-based telecommunications traffic monitoring system, according to another embodiment of the present invention, is illustrated. Plural telecommunication switches **301** send traffic data via a network A **303** to a statistics relay unit (SRU) **305**. The SRU **305** gathers the diverse traffic data from the switches **301** and sends it to an information condensing server **309**, via a network B **307**, for processing and transmission to display units **315**. Transmission between the information condensing server **309** and the display units **315** is handled via a network C **313**. The links between the display units **315** and the network C **313** may be via wire, wireless (e.g., RF, infrared), or a combination thereof.

Although the SRU **305** and the information condensing server **309** are portrayed as being remote from one another (communicating via a network B **307**), they may be considered to be functioning as a unified server system **311** that collectively receives, processes, and sends traffic information. The processing burden may be handled by either the SRU **305** or the information server **309**, or shared between the two.

Referring to **Fig. 4**, integration of plural telecommunications switches with a network-based telecommunications traffic monitoring system, according to yet another embodiment of the present invention, is illustrated. Each of a plurality of telecommunications switches **401** is connected to a respective SRU **403**. The SRUs **403** each receive traffic data from a switch **401** and transmit it on to an information condensing server **407**, via a network B **405**, for processing and transmission to display units **413**. Transmission between the information condensing server **407** and the display units **413** is handled via a network C **409**.

Although the SRUs **403** and the information condensing server **407** are portrayed as being remote from one another (communicating via a network B **405**), they may be considered to be functioning as a unified server system **411** that collectively receives, processes, and sends traffic information. The processing burden may be handled by either the SRUs **403** or the information condensing server **407**, or shared between the two.

Referring to **Fig. 5**, integration of plural telecommunications switches with a network-based telecommunications traffic monitoring system, according to still another embodiment of the present invention, is illustrated. A first telecommunications switch **501** is connected to provide traffic data to a first SRU **507**. Additional telecommunication switches **503** provide traffic data to an additional SRU **509** via a network **505**. The plural SRUs **507**, **509** provide the traffic data gathered from diverse sources to plural information condensing servers **513**. The data is transmitted form the SRUs **507**, **509** to the information condensing servers **513** via one or more networks **511**. Plural networks B1 through Bn are illustrated, however these may alternatively be implemented as a single network rather than plural. The information condensing servers **513** process the traffic data and transmit it to display units **519**. Transmission between the information condensing servers **513** and the display units **519** is handled via a network **517**.

Although the SRUs **507**, **509** and the information condensing servers **513** are portrayed as being remote from one another (communicating via networks **511**), they may be considered to be functioning as a unified server system **515** that collectively receives, processes, and sends traffic information. The processing burden may be handled by either the SRUs **507**, **509** or the information condensing servers **513**, or shared between them.

Referring to **Fig. 6**, integration of plural switches with a network-based telecommunications traffic monitoring system, according to a preferred embodiment of the present invention, is illustrated. A workstation **601** gathers traffic data from a telephone switch **603** via a data link **607**. The data link **607** may be a serial (e.g., RS-232) or x.25 connection. This data may be in the form of discrete files or data streams. The data gathered by the workstation **601** is periodically transferred according to file transfer protocol (FTP) to a network SRU **611**. The SRU **611** also gathers traffic data from additional switches **605** via a local area network (LAN) **609**. The network SRU **611** encrypts the traffic data and sends the encrypted data via FTP to a firewall **613** that interfaces with the Internet **615**. The use of encryption provides for a secure link when transmitting the data over the Internet **615**.

The traffic data is transferred via the Internet from the firewall **613** to a data condensing server **617** that hosts a traffic monitoring web site (e.g., "trafficmonitoring.com" or "trunkmeter.com"). The web site at server **617** permits multiple clients to access traffic data according to their respective permissioning rights. A particular client **619** accesses the server **617** to retrieve that client's respective information by performing a hypertext transfer protocol (HTTP) transaction via the Internet **615**.

Referring to **Fig. 7**, integration of plural telecommunications switches with a network-based telecommunications traffic monitoring system, according to another embodiment of the present invention, is illustrated. Plural telecommunication switches **701** send traffic data to a co-located monitor server **705** using a convenient local transmission scheme **703** (e.g., TCP/IP or serial RS-232). This server **705** combines the functional aspects, as depicted in other embodiments, of a statistics relay unit (SRU) for gathering the diverse traffic data from

the switches **701** with an information condensing processor. This analysis is transmitted, using a TCP/IP link **707**, via an intranet network **709**, to network surveillance display units **711**. The display units are depicted as using a web browser to display the information. Additionally, they may use other multimedia forms of delivery including audible signaling.

While the link between the switches **701** and the monitor server **705** have been described as a serial cable or TCP/IP cable link, the transmission between the switches **701** and the monitor server **705** may be wireless (e.g., RF or infrared) or some combination of wire and wireless. Further, the linkage **703** may be part of the same intranet network **709** used to transmit the processed information. The links between the display units **711** and the intranet network **709** may also be via wire, wireless (e.g., RF or infrared), or a combination thereof. Of course the network **709** need not be limited to an intranetwork implementation, and is optionally embodied as an open network, including for example, a global communications network of interconnected networks.

Comparing the embodiment of Fig. 7 with that illustrated in Fig. 3, it is seen that although the SRU **305** and the information condensing server **309** are portrayed as being remote from one another (communicating via a Network B **707**), they may be considered (conceptually, at least) to be functioning as a unified server system **311** that collectively receives, processes, and sends traffic information. The processing burden may be handled by either the SRU **305** or the information server **309**, or shared between the two. The embodiment of Fig. 7 takes this conceptualization one step further and actually condenses the functionalities of the two separate servers of the Fig. 3 embodiment into only a single server (or, equivalently, plural co-located servers operating so as to emulate a single server).

Referring to **Fig. 8**, an example of a switch traffic status display page is illustrated. The switch traffic status display is relatively high level and it indicates that data from five separate switches (according to this example) is available for viewing. It also provides abbreviated information about each of the five switches, such as how current the latest data is, the number of trunk groups (TGs) in overflow state and the number of TGs that are over 90% utilized.

Referring to **Fig. 9**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein only basic statistics are displayed. Statistics are displayed for each trunk group regarding utilization, out of service trunks, and overflow status. A textual description is also shown for each trunk group.

Referring to **Fig. 10**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein full statistics are displayed. In addition to out of service and overflow statistics, numerical information is also shown for number of trunks required, number of trunks available, mean hold time, answer/seizure ratio, etc.

Referring to **Fig. 11**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein peak usage data are displayed. The trunk groups are displayed in descending order according to their utilization at their respective peak times.

Referring to **Fig. 12**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein raw traffic data from a switch is displayed.

Referring to **Fig. 13**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein availability of data from a switch is displayed. The "nd" notations indicate hours in a given day for which no data was available from the switch. This view is useful for helping the user evaluate at a glance how reliable the statistics are for a given time period.

Referring to **Fig. 14**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to overflow status. This view is useful for quickly spotting overflow priorities.

Referring to **Fig. 15**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to the number of trunks in a trunk group that are out of service. This view is useful for quickly spotting trunk groups that have the largest numbers of out of service trunks.

Referring to **Fig. 16**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to mean hold time statistics for calls for each trunk group. The mean hold time for each trunk group helps a network engineer assess how much extra capacity may be appropriate for avoiding under capacity situations at peak usage.

Referring to **Fig. 17**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted according to the answer/seizure ratio (ASR) statistics for each trunk group. This is an indication of how much of the traffic can be billed to customers.

Referring to **Fig. 18**, an example is shown of a switch traffic display page, according to an embodiment of the present invention, wherein trunk data is sorted for purposes of analyzing trunk group sizing based on sufficiency of traffic capacity. At the top of the view is a single trunk group that is characterized as being "without enough capacity." The remaining trunk groups are labeled as having "sufficient or extra capacity." Each trunk group is assigned an Over/Under Trunking value and is ranked accordingly in the view.

The present invention facilitates traffic engineering by providing display of thirty-day peak traffic values with the number of trunks required to handle peak traffic. In a more time sensitive context, the present invention's near real time traffic graphs let translations engineers and managers see the effects of routing and translations changes as soon as possible.

Network operations personnel can see at a glance, both before and during maintenance activities, how many trunks need to be kept in service to accommodate customer traffic. For purposes of network optimization, the trunk group sizing display (refer to Fig. 18) shows which routes are most over-trunked or under-trunked.

According to an alternate embodiment, identification of an under-trunk (or over-trunk) situation is handled in an automatic fashion. Predetermined resource utilization thresholds (either simple or complex) are used to make an automatic decision for re-allocating trunks to better accommodate customer traffic. For example, a business that leases a nominal number of lines from a local communications service provider can purchase additional lines for its use via an automated, threshold-based algorithm, according to a pre-arranged agreement. This

permits dynamic management of resource utilization so as to prevent a traffic handling crisis without the need for constant monitoring by a skilled operator.

In an over-trunk situation, an automated algorithm according to this embodiment provides for incremental portions of the business's lines to be removed from service (preferably, as provided for by a pre-arranged agreement), so that those lines are free to be used by other entities.

Resource re-allocation according to either the under-trunk or over-trunk situations is done automatically, with a contemporaneous notification to the affected parties: operating personnel monitoring the operations of the switch, as well as the relevant managers of the customers affected by the changes.

An alternate embodiment of the invention is that the server is adapted to analyze traffic data for a subset of trunks or trunk groups that are utilized by an individual subscriber. That subscriber is provided with access only to the data that corresponds to the subset of trunks or trunk groups that subscriber utilizes. This allows for information delivery to be pinpointed to the specific user (or users) for whom the subset monitoring is appropriate.

Placing the data to be displayed on a server that can be accessed via the Internet puts the data in the hands of any authorized person (i.e., in possession of current passwords, etc.) to review all the above-discussed information online via any computer implementing a standard web browser.

The present invention has been described in terms of preferred embodiments, however, it will be appreciated that various modifications and improvements may be made to the described embodiments without departing from the scope of the invention.